

Assessment and Restoration of Riparian Ecosystems at a Watershed Scale

Orange, Riverside, and San Diego Counties, CA



Special Area Management Plan

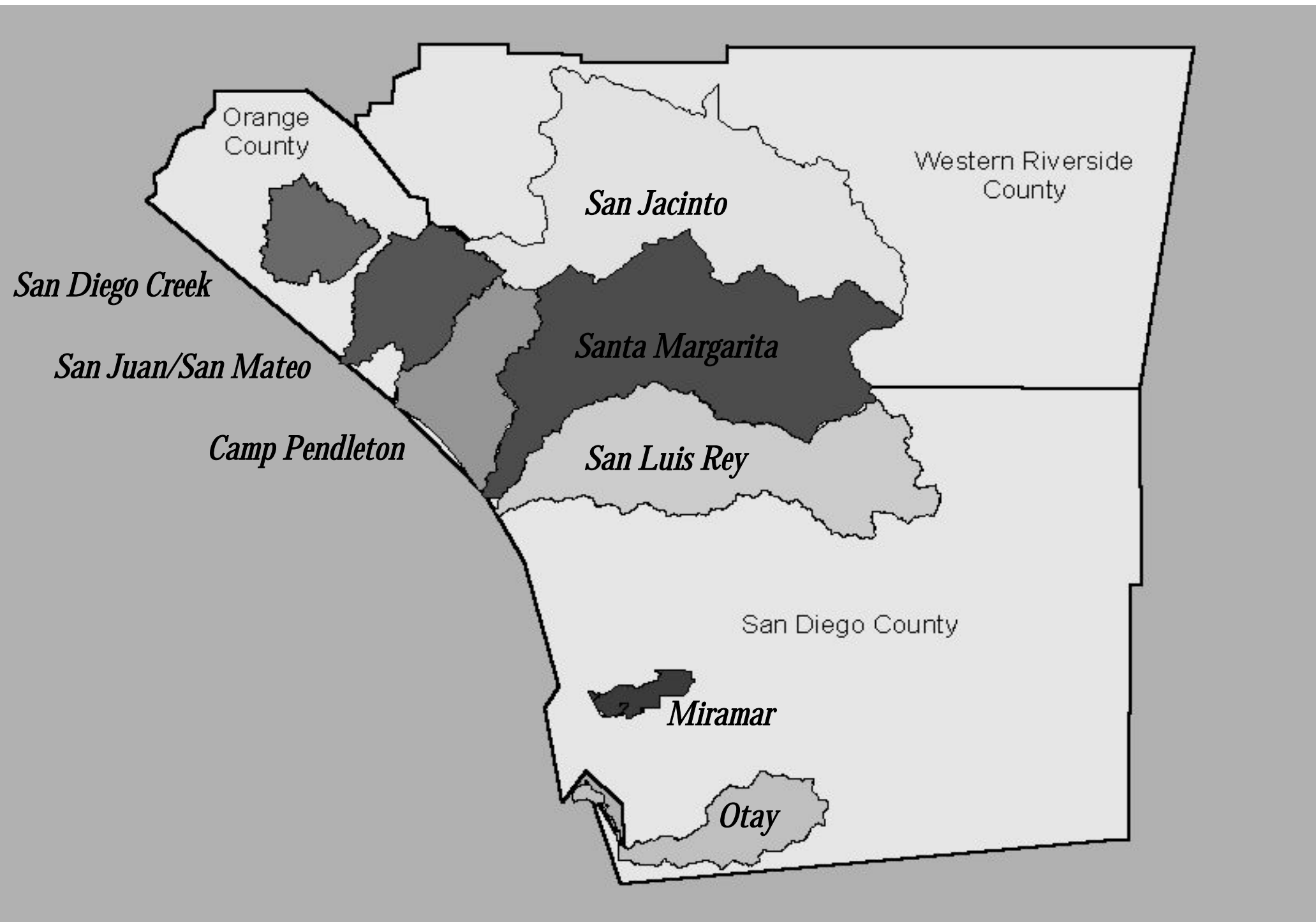
- LA District Corps of Engineers is conducting a SAMP for several watersheds in southern California
- Objective and requirements of SAMP are to...
 - Conducted in areas undergoing rapid development with heavy permitting activity
 - Establish general programmatic permits for activities regulated under the 404 Program
 - Involve federal, state, and local governmental agencies as well as non-governmental stakeholders
 - Establish protection and management areas in coordination with the Natural Community Conservation Plan (NCCP) and Habitat Conservation Plan (HCP)

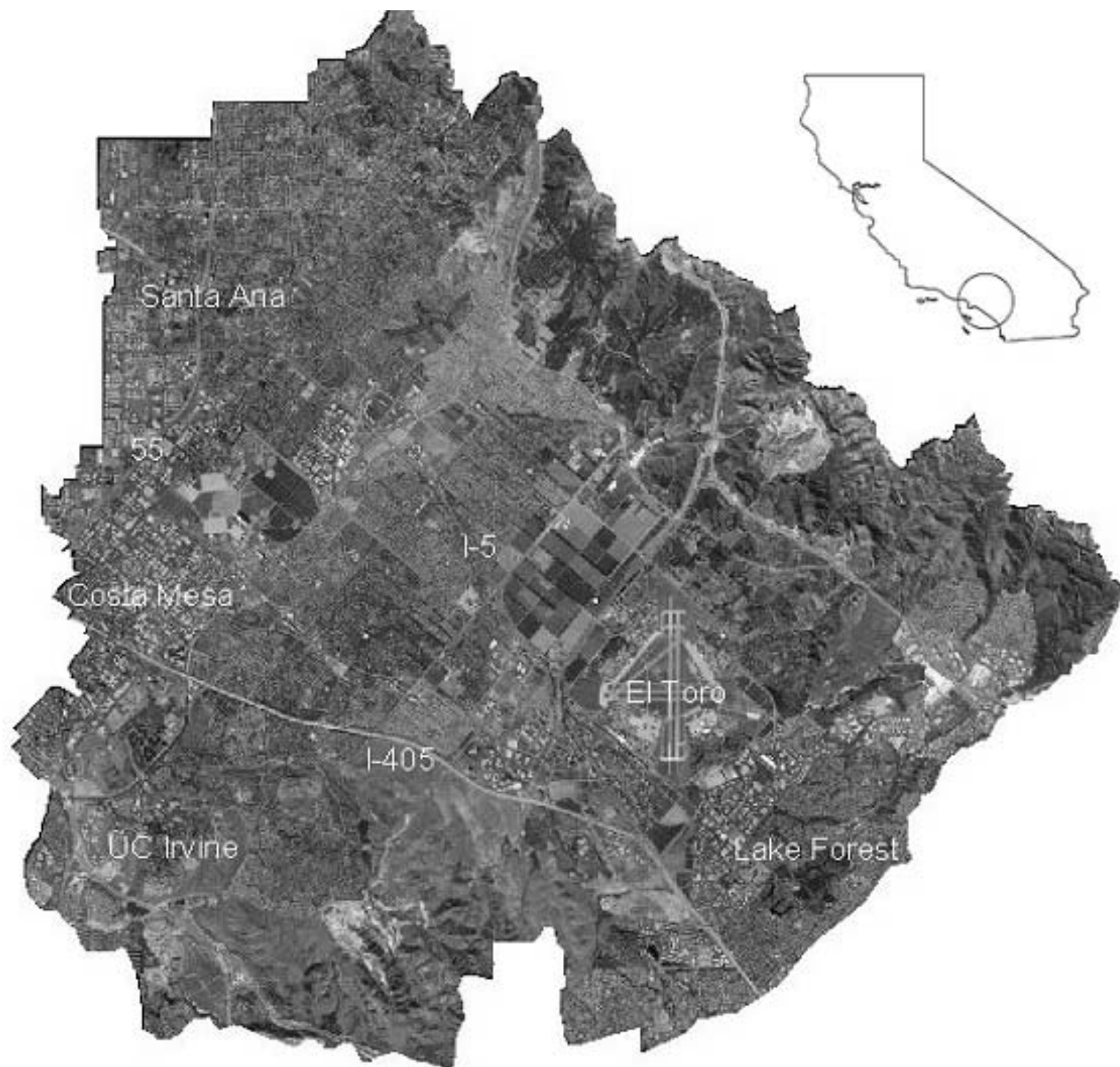




Project Components

- Identification of riparian ecosystems
- Assessment of riparian ecosystem integrity
- Development and analysis of alternatives
- Development of a watershed wide restoration plan for riparian ecosystems
- Supplementary studies



















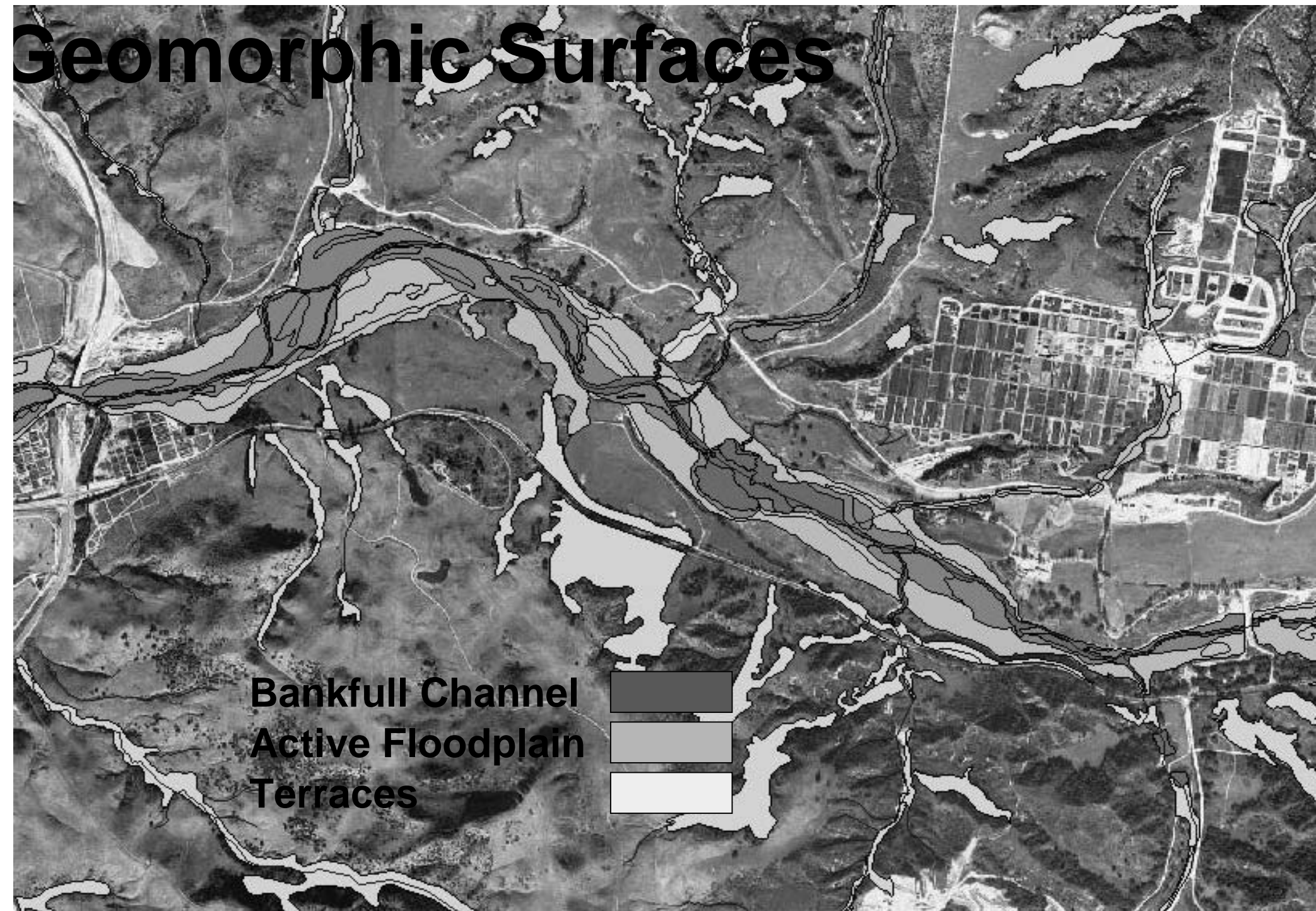
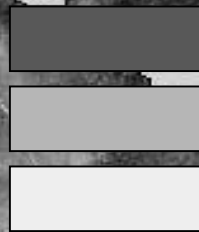


Phase 1: Identifying Riparian Ecosystems

- Planning level delineation of riparian ecosystems, wetland, and non-wetland waters delineated by Bob Lichvar (CRREL)
- Develop an initial map of geomorphic surfaces and vegetation community using remotely sensed data
- Ground-truth a subset of mapped lines and polygons
- Assign a probability of jurisdictional status to each mapped line and polygon

Geomorphic Surfaces

Bankfull Channel
Active Floodplain
Terraces



Vegetation Communities



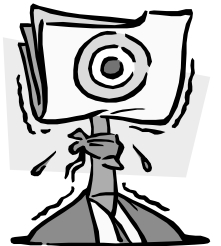
WoUS and Wetlands of the San Juan / San Mateo



1 0 1 2 3 4 Kilometers

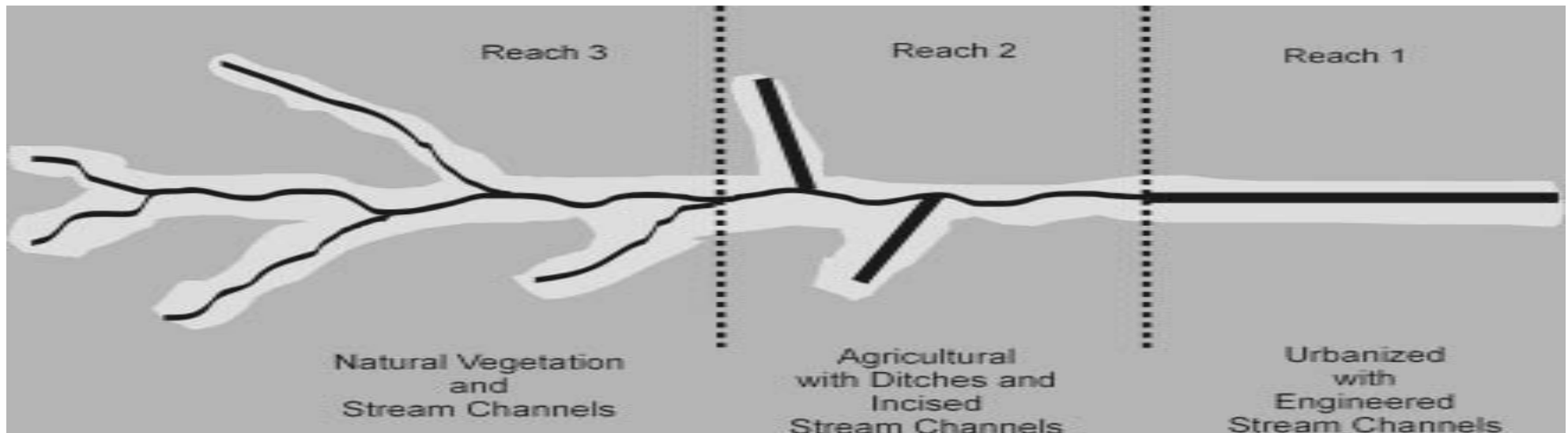
Phase 2: Assessing Riparian Ecosystem Integrity

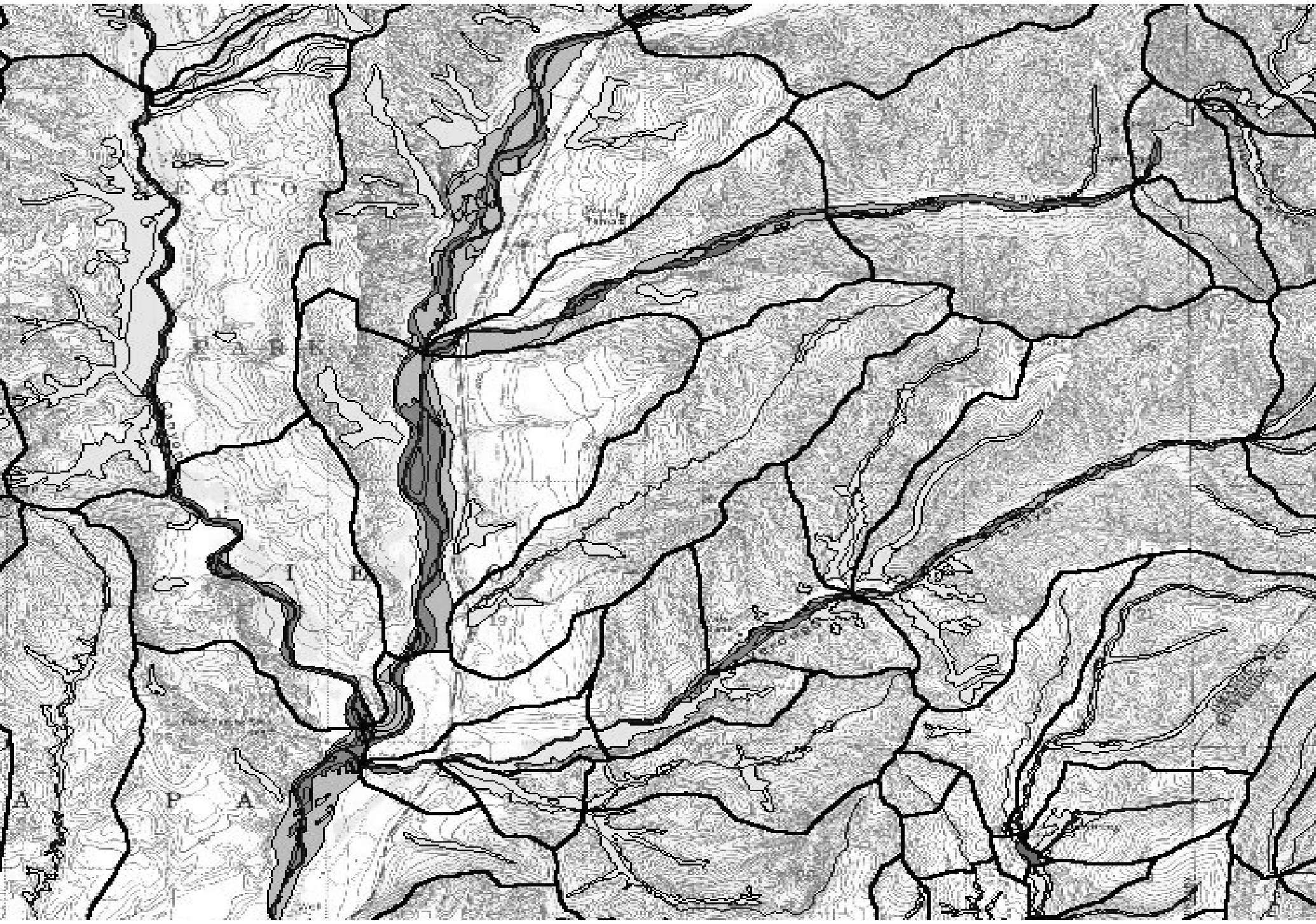
- Tasks
 - Define riparian ecosystem assessment units
 - Assess integrity of these riparian areas using "indicators" and characterize them in terms of a variety of other factors
 - Combine indicators into hydrologic, water quality, and habitat integrity indices
 - Summarize results graphically and spatially



Riparian Reaches

- Riparian reach assessment units are defined as a segment of riparian ecosystem along mainstem channels that are relatively homogeneous with respect to geology, geomorphology, channel geometry, channel substrate, vegetation communities, cultural alteration, and other factors
- Riparian reaches are initially identified using maps and aerial photos then refined during field reconnaissance

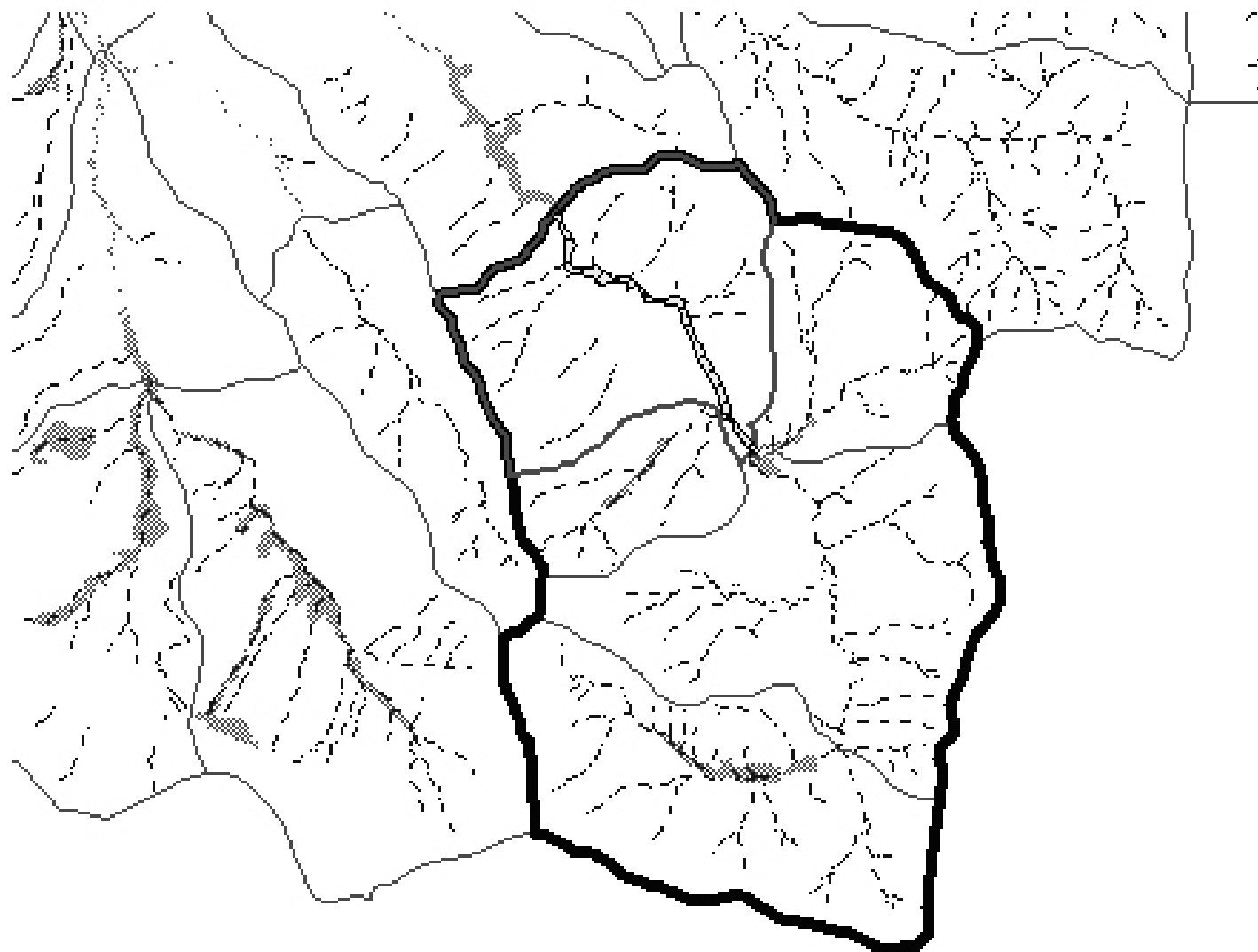










Assessment Indicators

- “Indicators” are the metrics used to assess hydrologic, water quality, and habitat integrity
- Indicators were developed at three spatial scales:
 - Riparian reach
 - Local drainage
 - Drainage basin





-  Riparian Reach 1 (RR-1)
-  RR-1 Local Drainage Boundary
-  RR-1 Drainage Basin Boundary
-  Other Local Drainage Boundaries
-  Non Wetland Waters
-  Wetlands

Hydrologic Indicators

- Hydrologic indicators were selected to reflect:
 - The frequency, magnitude, and temporal distribution of stream discharge
 - Interaction between the stream channel and the floodplain



Hydrologic Indicators

- Hydrologic indicators included:
 - Altered Hydraulic Conveyance
 - Surface Water Retention in lakes, reservoirs, and ponds
 - Perennialized Stream Flow
 - Hydrologic Interaction between stream channel and floodplain
 - Import, Export, and Diversion of Surface Water



Water Quality Indicators

- Water quality indicators were selected to reflect:
 - Land use in a drainage basin with respect to the potential increase in non-point pollutants
 - The stream delivery system in terms of magnitude, frequency, and temporal distribution
 - Hydrologic interaction between stream channel and floodplain



Water Quality Indicators

- Water quality indicators included:
 - Land Use/Land Cover - Nutrient Increase
 - Land Use/Land Cover - Pesticide Increase
 - Land Use/Land Cover - Hydrocarbon Increase
 - Land Use /Land Cover - Sediment Increase
 - Altered Hydraulic Conveyance - Reach Scale
 - Altered Hydraulic Conveyance - DB Scale
 - Surface Water Retention
 - Perennialized Stream Flow
 - Import, Export, or Diversion of Surface Water
 - Floodplain Interaction
 - Sediment Regime
 - Extent of Riparian Plant Communities



Habitat Indicators

- Habitat indicators were selected to reflect:
 - Spatial extent and quality of riparian habitat
 - "Continuity / Connectedness" of riparian habitat at riparian reach and drainage basin scales
 - Spatial extent and quality of adjacent non-riparian, upland habitats in the local drainage



Habitat Indicators

- Extent of Riparian Plant Communities
- Extent of Exotic Plant Species
- Riparian Corridor Continuity - Riparian Reach Scale
- Riparian Corridor Continuity - Drainage Basin Scale
- Land Use / Land Cover - Riparian/Upland Boundary
- Land Use / Land Cover - Upland Buffer



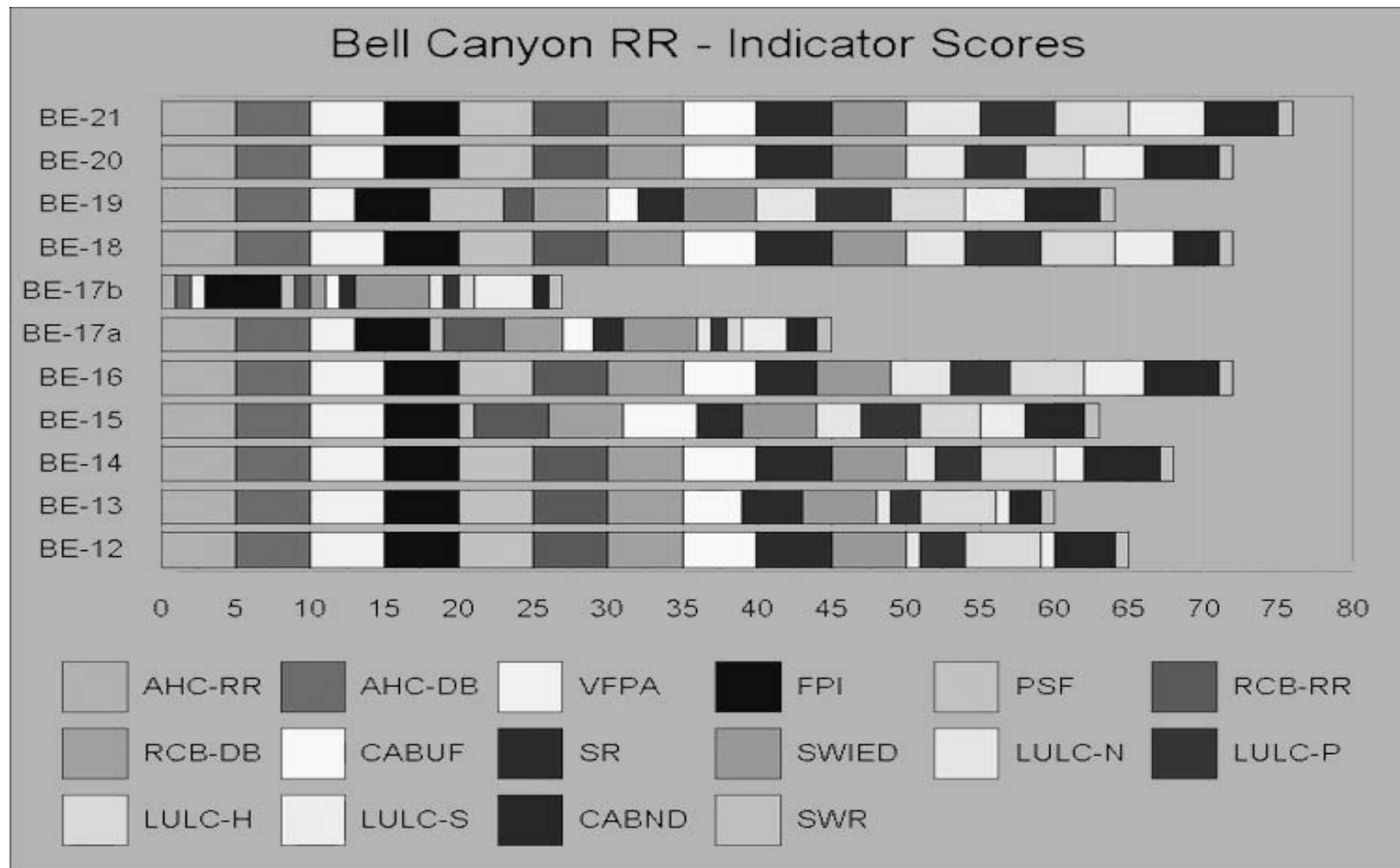


Integrity Indices

- Indicator metric values were assigned to riparian reaches in the field
- Values were converted to a score based on an ordinal scale relationship between indicators and a culturally unaltered "reference condition"
- Relevant indicator scores were summed to give hydrologic, water quality and habitat integrity indices

Indicator Metric Value Range	Score
<5% of basin drains to surface water storage facilities	5
>5 and <15% of basin drains to surface water storage facilities	4
>15 and <30% of basin drains to surface water storage facilities	3
>30 and <50% of basin drains to surface water storage facilities	2
>50% of basin drains to surface water storage facilities	1

Graphical Summary of Results



Riparian Reach Database Report

General Information

Drainage Basin: Aqua Chinon
Riparian Reach ID: AC-05
USGS 7.5 Minute Topo: El Toro
UTM Coordinates Downstream End:
11S 434762mE 3727275mN
UTM Coordinates Upstream End:
11S 435088mE 3727338mN
Size of Riparian Reach: 32.8 ha
Size of Drainage Basin: 700 ha
Area of Riparian Ecosystem: 1 ha



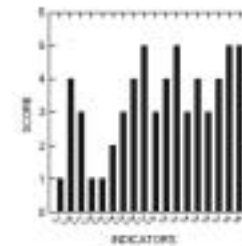
Channel Characteristics

Channel Type or Rosgen Stream Type if Natural Channel: C and D
Length of Mainstem Channel Through Reach: 1000 m
Channel Substrates (Natural Channels Only):
% Bedrock or Boulder: 0
% Cobble: 10
% Gravel: 20
% Sand: 60
% Silt / Clay: 10
Channel Geometry in Representative Section of Lower Portion of Reach:
Bankfull Width: 4.6 m
Flood Prone Width: 5.8 m
Mean Bankfull Depth: 38.1
Bankfull Cross-Sectional Area: 1.7 m²

Indicators of Functional Integrity

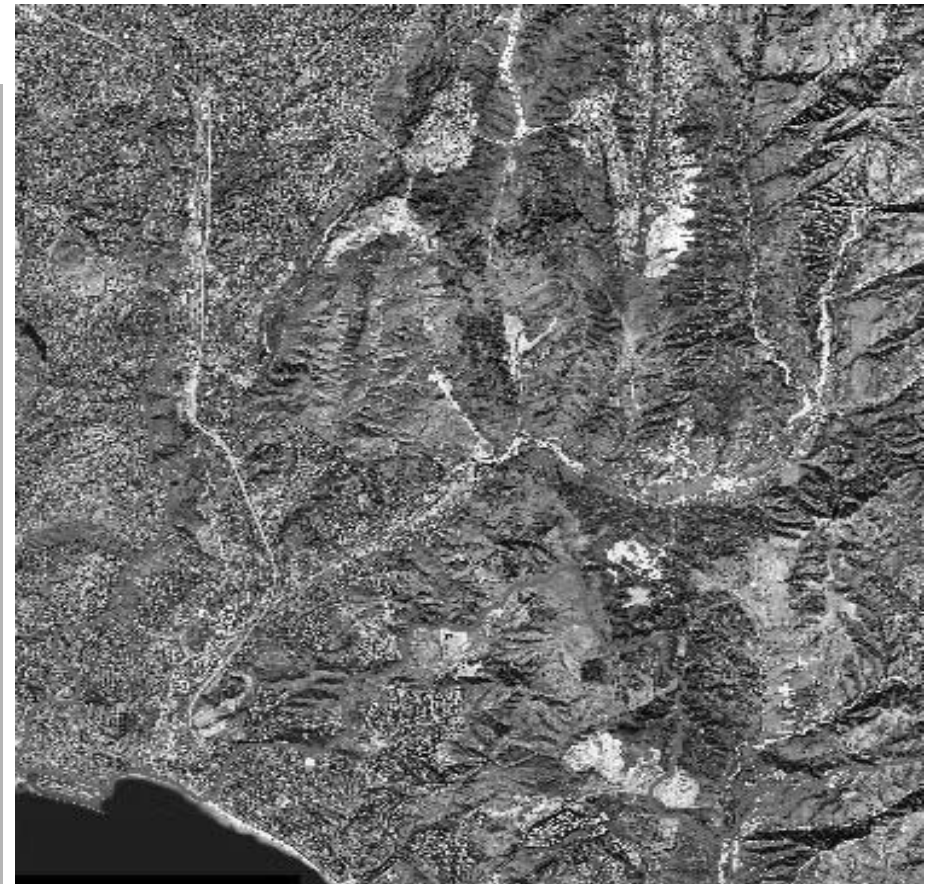
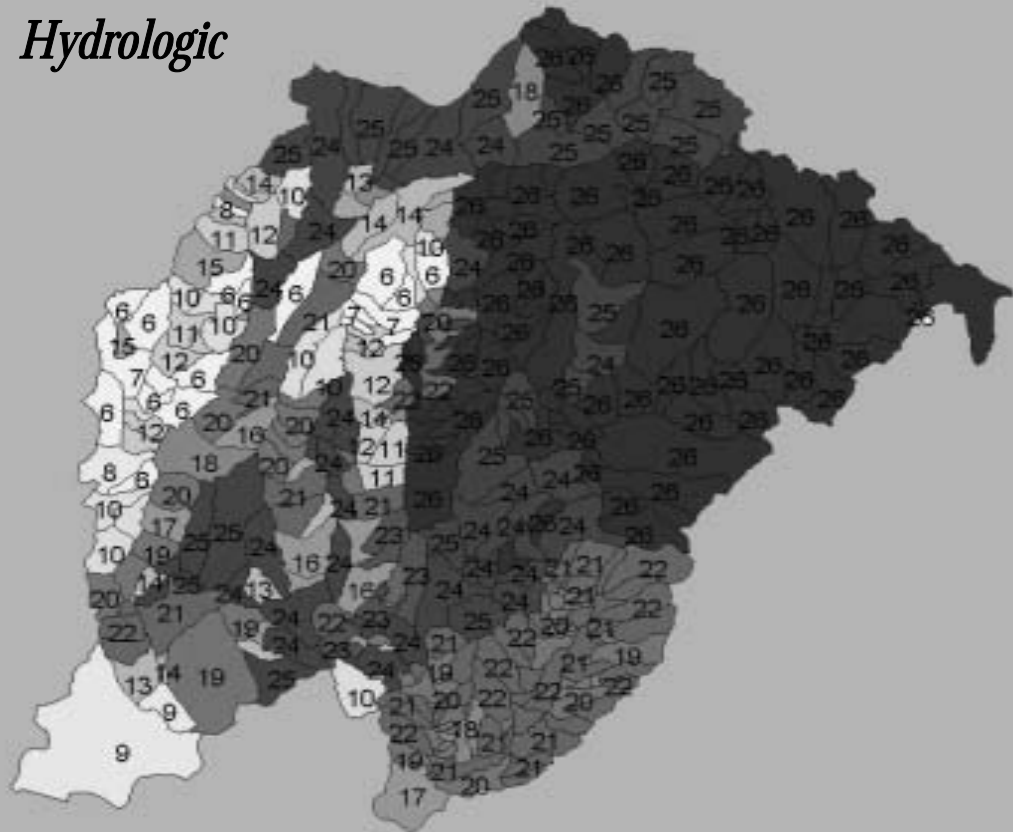
% of Drainage Basin Surface Water Imported, Exported, or Diverted: 0
% of Drainage Basin affected by Surface Water Storage Structures: 93
% of Drainage Basin with Land Uses that increase surface water nutrients: 93
% of Drainage Basin with Land Uses that increase surface water pesticides: 93
% of Drainage Basin with Land Uses that increase surface water hydrocarbons: 93
% of Drainage % of Reach with Altered Hydraulic Conveyance: 0
% of Drainage Basin with Altered Hydraulic Conveyance: 16
% of Floodplain Removed or Isolated from Channel: 0
% of Channel with Perennial Flow Basin with Land Uses that increase surface water sediments: 93
% of Flood Prone Area in Reach Functioning as Corridor Breaks: 0
% of Flood Prone Area in Drainage Basin Functioning as Corridor Breaks: 0
% of Riparian Ecosystem Boundary with Culturally Altered Land Uses: 100
% of Riparian Ecosystem Buffer (100 m) with Culturally Altered Land Uses: 100
% of Flood Prone Area supporting Native Riparian Vegetation: 100

Indicator Scores For Riparian Reach AC-05

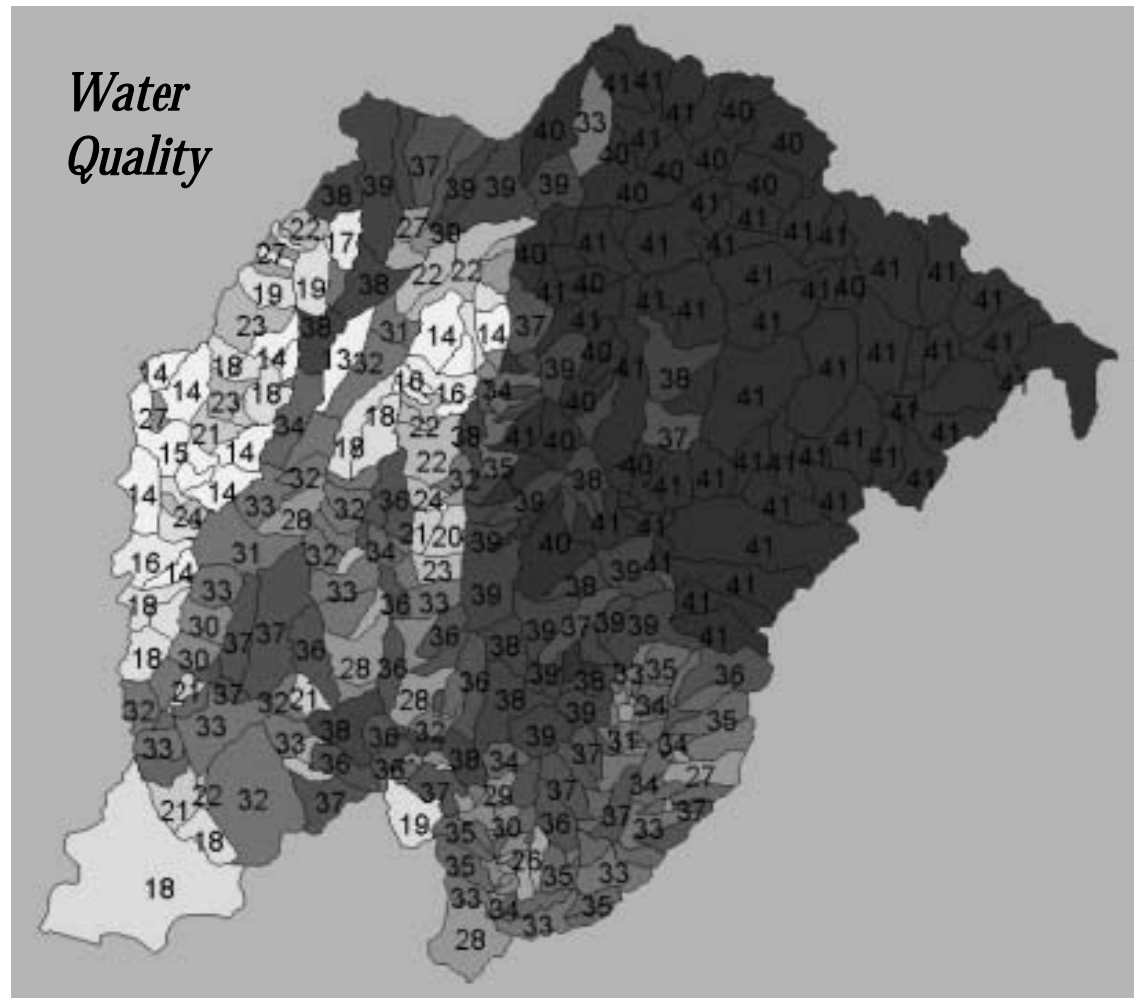


Spatial Display of Integrity Indices

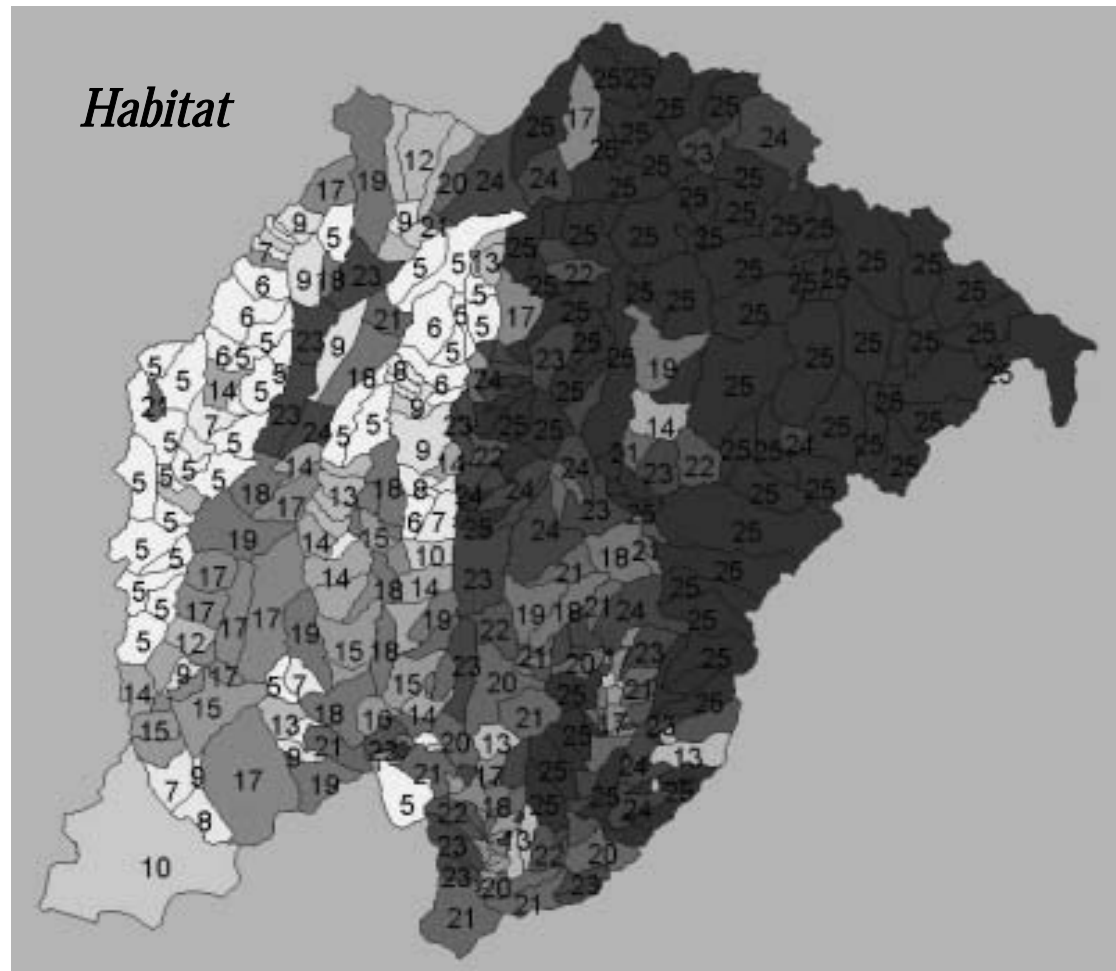
Hydrologic



Spatial Display of Integrity Indices



Spatial Display of Integrity Indices

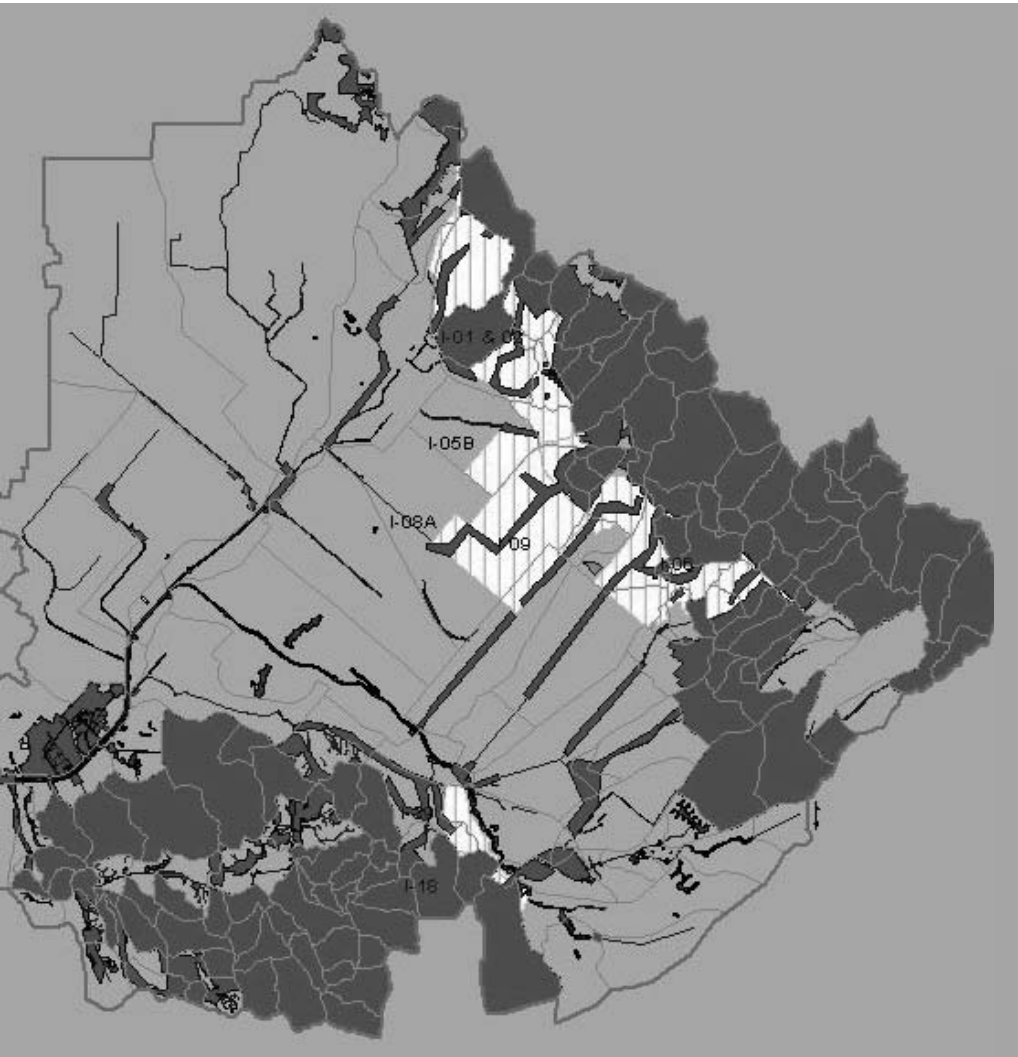


Phase 3: Alternatives Analysis

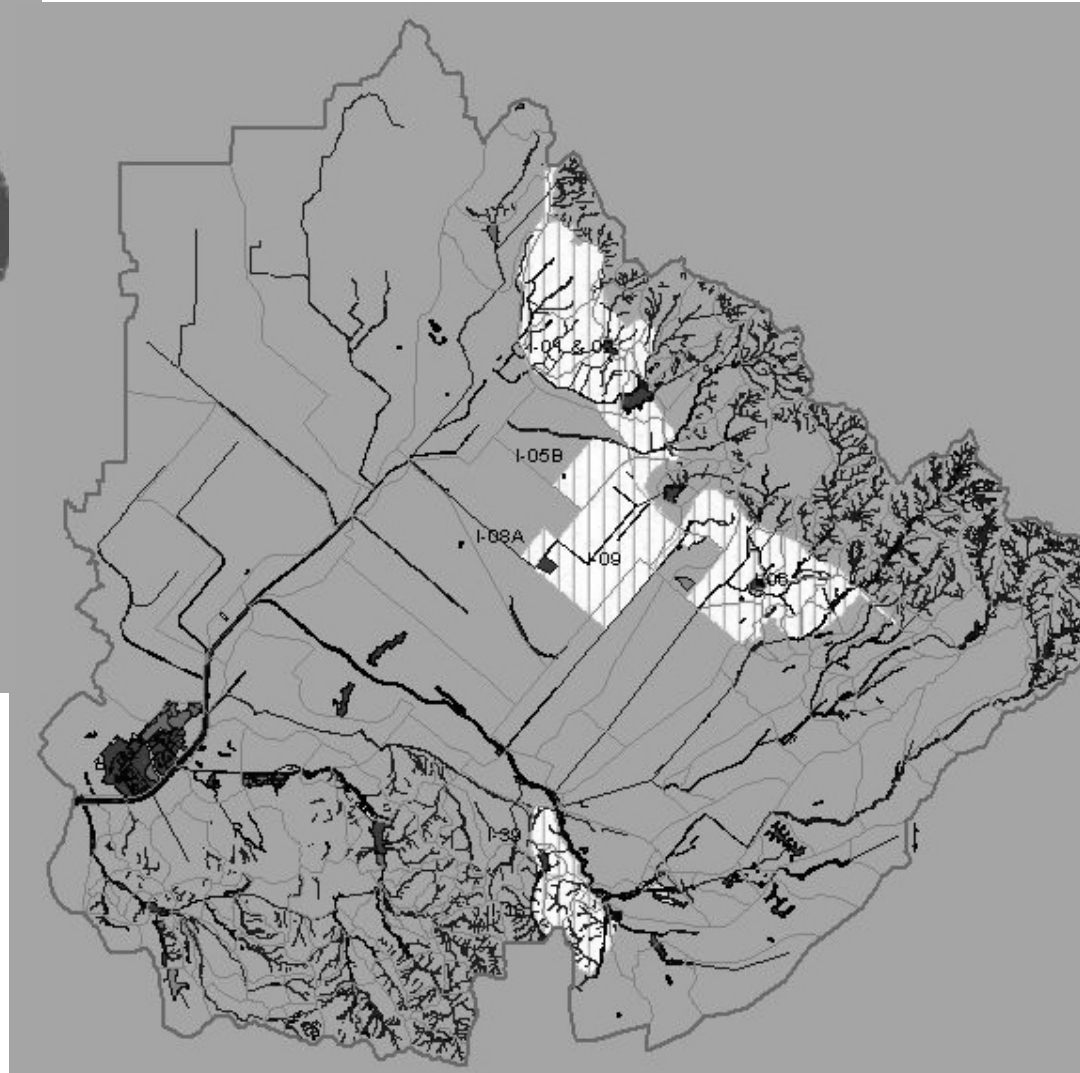
- Establish a "corps preferred" alternative based on:
 - Riparian reaches with a medium to high level of hydrologic, water quality, and habitat integrity
 - Riparian reaches with the potential to serve as corridors connecting existing large patches of riparian ecosystem
 - Aquatic resources and associated upland habitat currently supporting federally and state listed and sensitive species
 - Aquatic resources designated as critical habitat, management, conservation, or research reserve areas
- Analyze this and other alternatives through a comparison of direct and indirect impacts
 - No action (i.e., business as usual)
 - No future permits
 - Existing General Land Use Plan



*General Land Use Plan Alternative
“Impact Area”*



*Corp Preferred Alternative
“Avoidance Area”*



Alternatives Analysis Criteria

- Criterion 1: Wetland and non-wetland stream channels directly impacted
- Criterion 2: Main stem stream channels indirectly impacted
- Criterion 3: Riparian ecosystems directly impacted
- Criterion 4: Riparian ecosystems on main stem stream channels indirectly impacted
- Criterion 5: Critical habitat of threatened, endangered, and sensitive species directly impacted
- Criterion 6: Threatened, endangered, and sensitive species directly impacted (buffered observation points)
- Criterion 7: Quantity of hydrologic, water quality, and habitat integrity units for riparian ecosystems directly impacted
- Criterion 8: Quantity of hydrologic, water quality, and habitat integrity units for riparian ecosystems indirectly impacted
- Criterion 9: Change in hydrologic, water quality, and habitat integrity units for riparian ecosystems directly and indirectly impacted

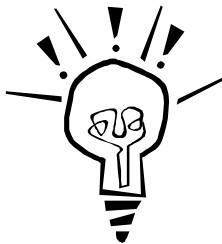


Table 2. Summary of potential direct and/or indirect impacts for each proposed alternative under Criteria 1

Proposed Alternative	Non-Wetland Waters Subject to Direct Impact (km)	Percent of SDCW	Non- Wetland Waters Subject to Indirect Impact (km)	Percent of SDCW	Wetlands Subject to Direct Impact (ha)	Percent of SDCW	Wetlands Subject to Indirect Impact (ha)	Percent of SDCW
Alternative 1	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
Alternative 2	0	0	38.5	8.2	0	0	263.8	25.4
Alternative 3	35.8	7.6	38.5	8.2	102.5	9.9	263.8	25.4
Alternative 4	17.3	3.8	17.3	3.8	304.4	29.3	304.4	29.3



Phase 4: Watershed Restoration

- Objective was to establish priorities for restoration of riparian ecosystems in the watershed
- Approach
 - Classify each riparian reach by geomorphic zone
 - Determine current condition and identify appropriate restoration template
 - Estimate level of effort for restoration
 - Simulate the change in hydrologic, water quality, and habitat indices following application of restoration template
 - Identify priority restoration areas based on selected criteria

Mountains and Foothills

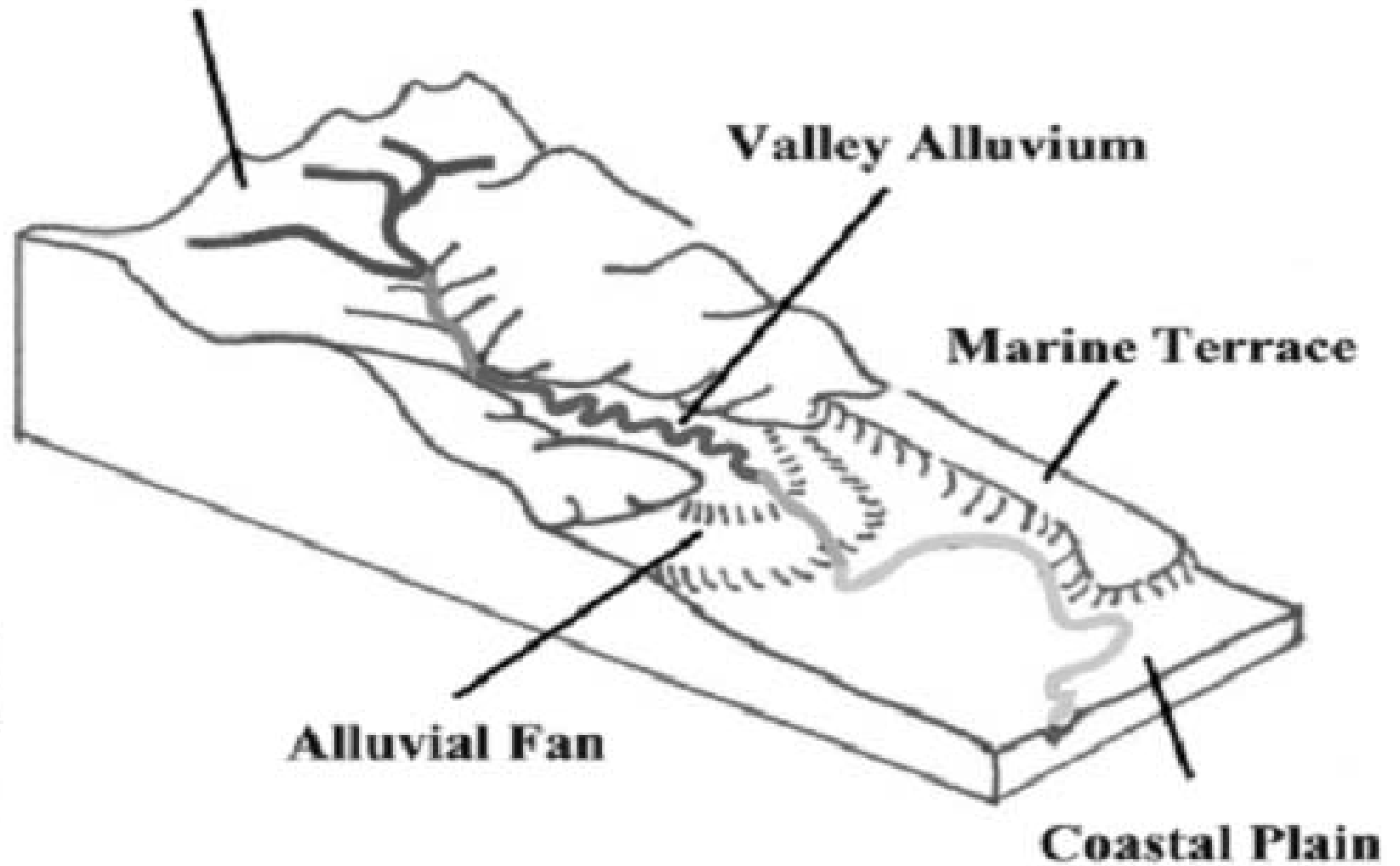
Valley Alluvium

Marine Terrace

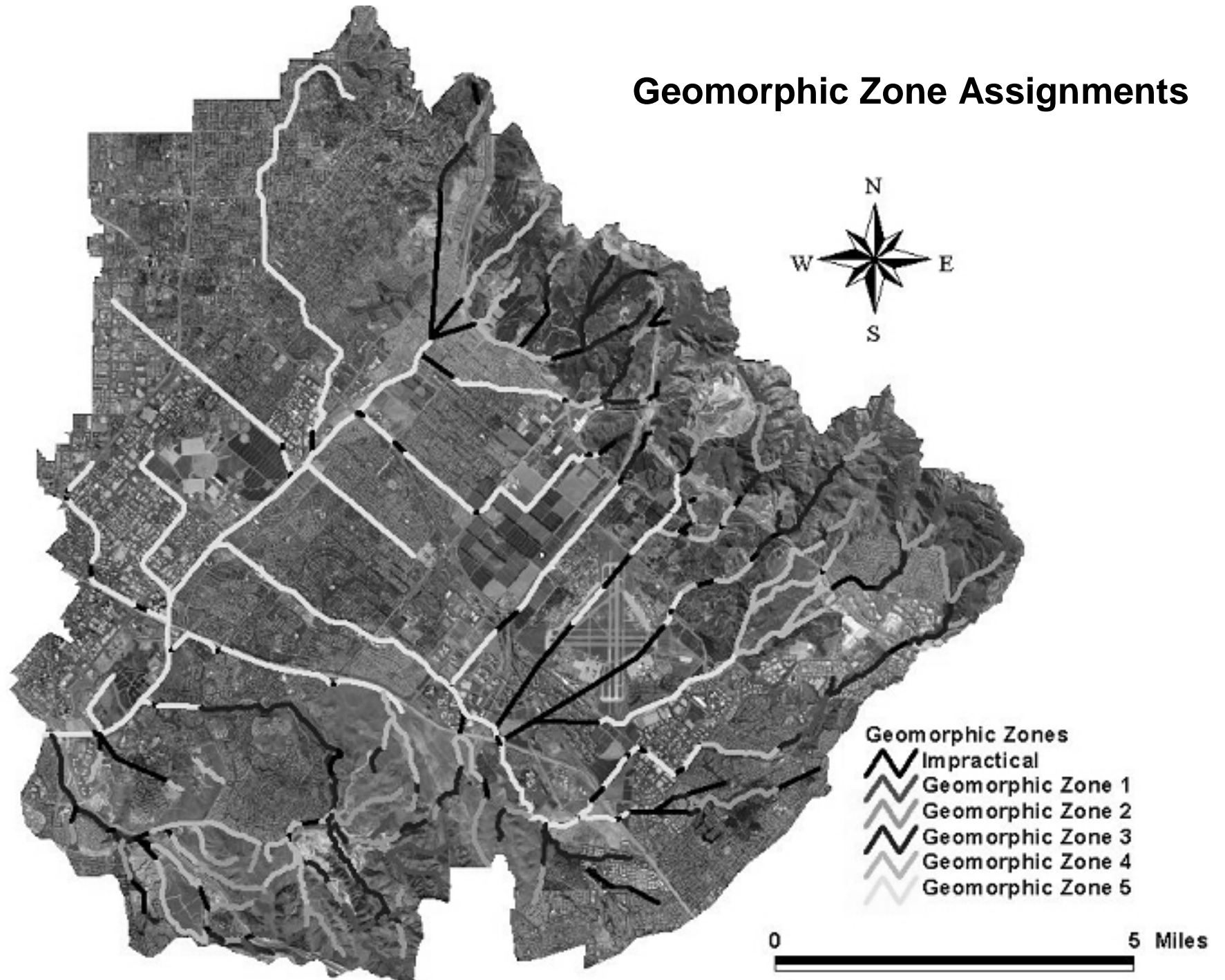
Alluvial Fan

Coastal Plain

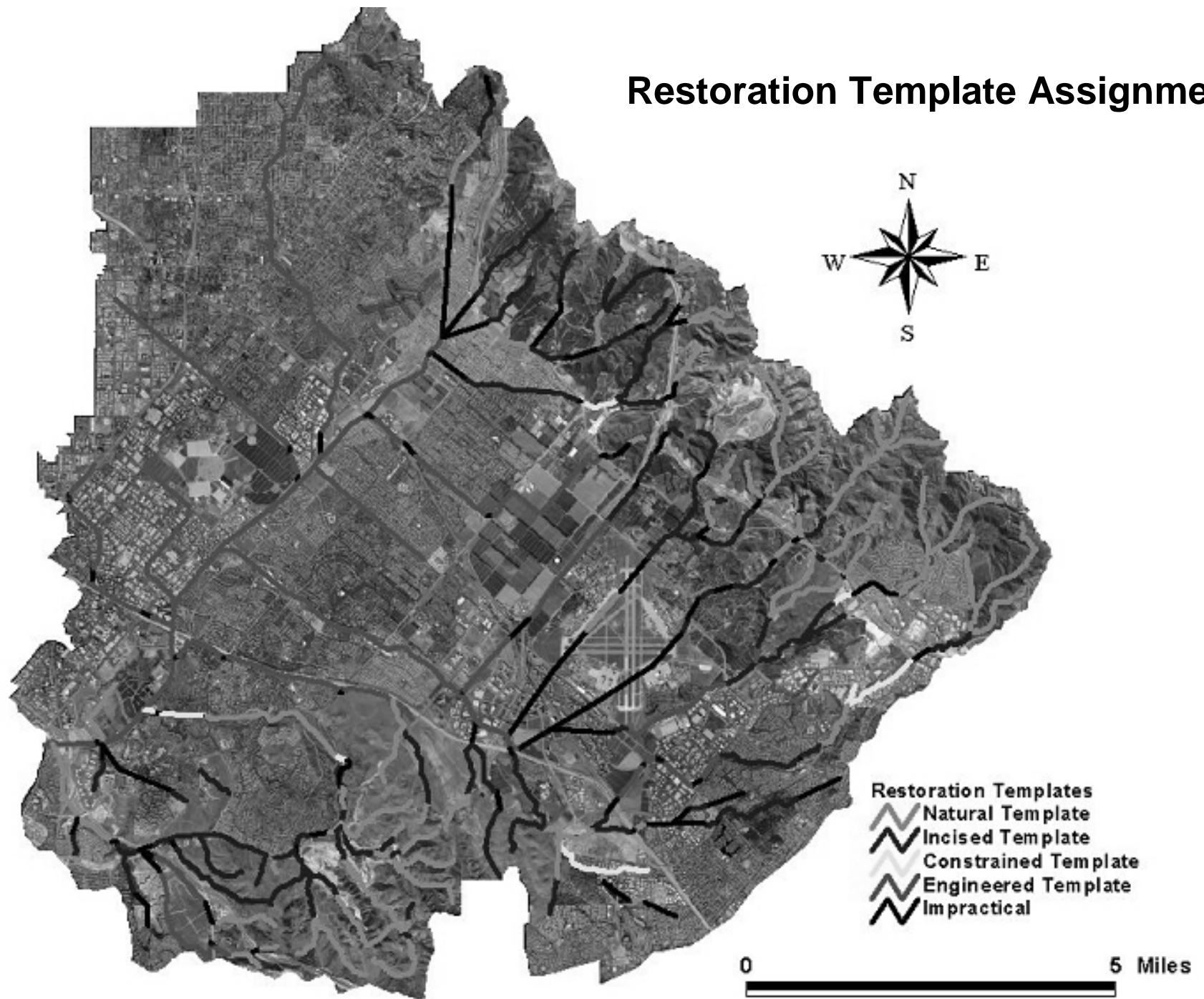
Zone 1 —
Zone 2 —
Zone 3 —
Zone 4 —
Zone 5 —



Geomorphic Zone Assignments

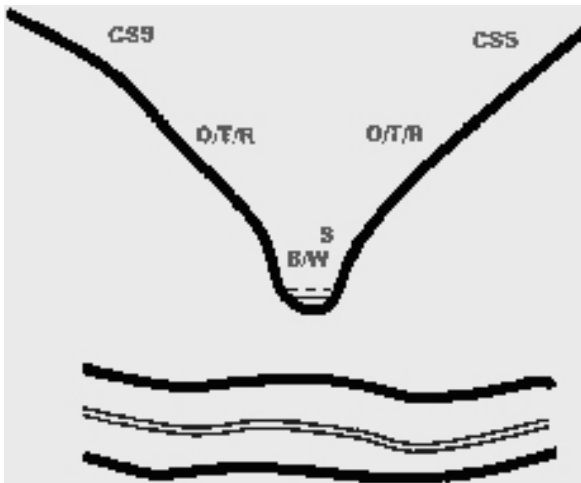


Restoration Template Assignments

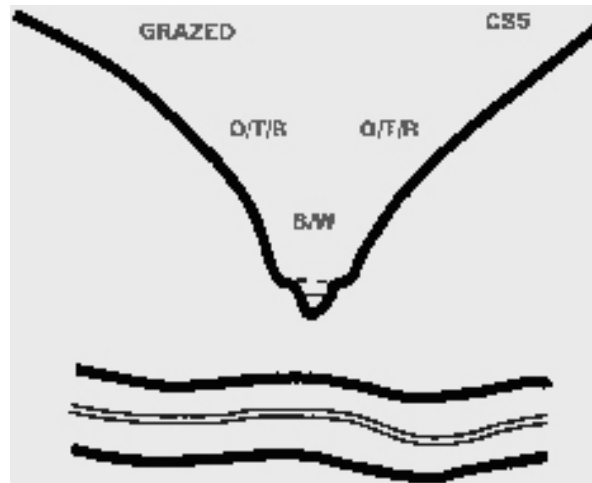


Zone 1 Restoration Specifications

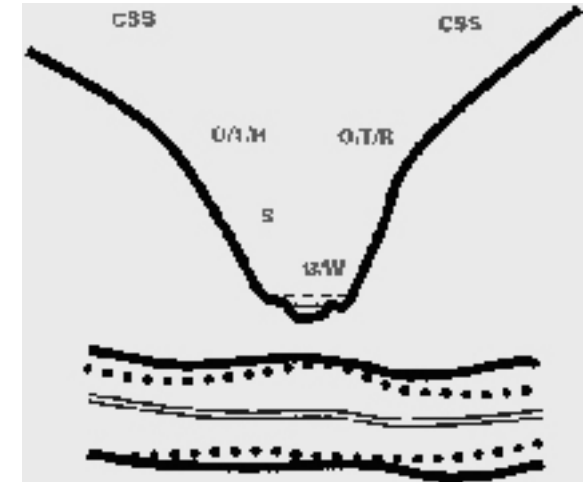
Natural Condition



Incised Condition



Restoration Template



Bankfull Width: 1.5 m

Bankfull Depth : 0.15 m

Floodprone Width: 2.4 m

First Terrace

Width: 1.8 m

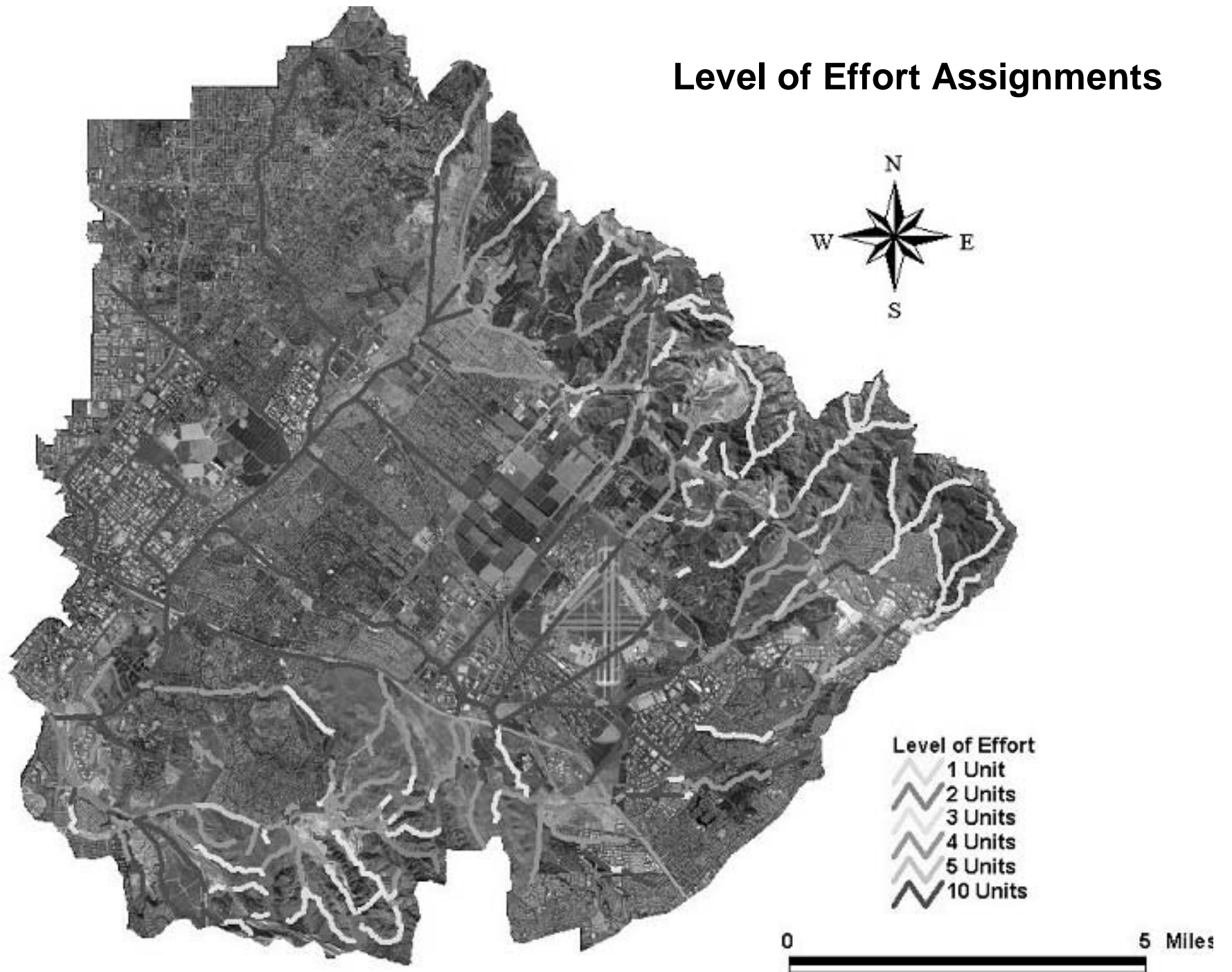
Height above Bankfull: 0.45 m

Second Terrace

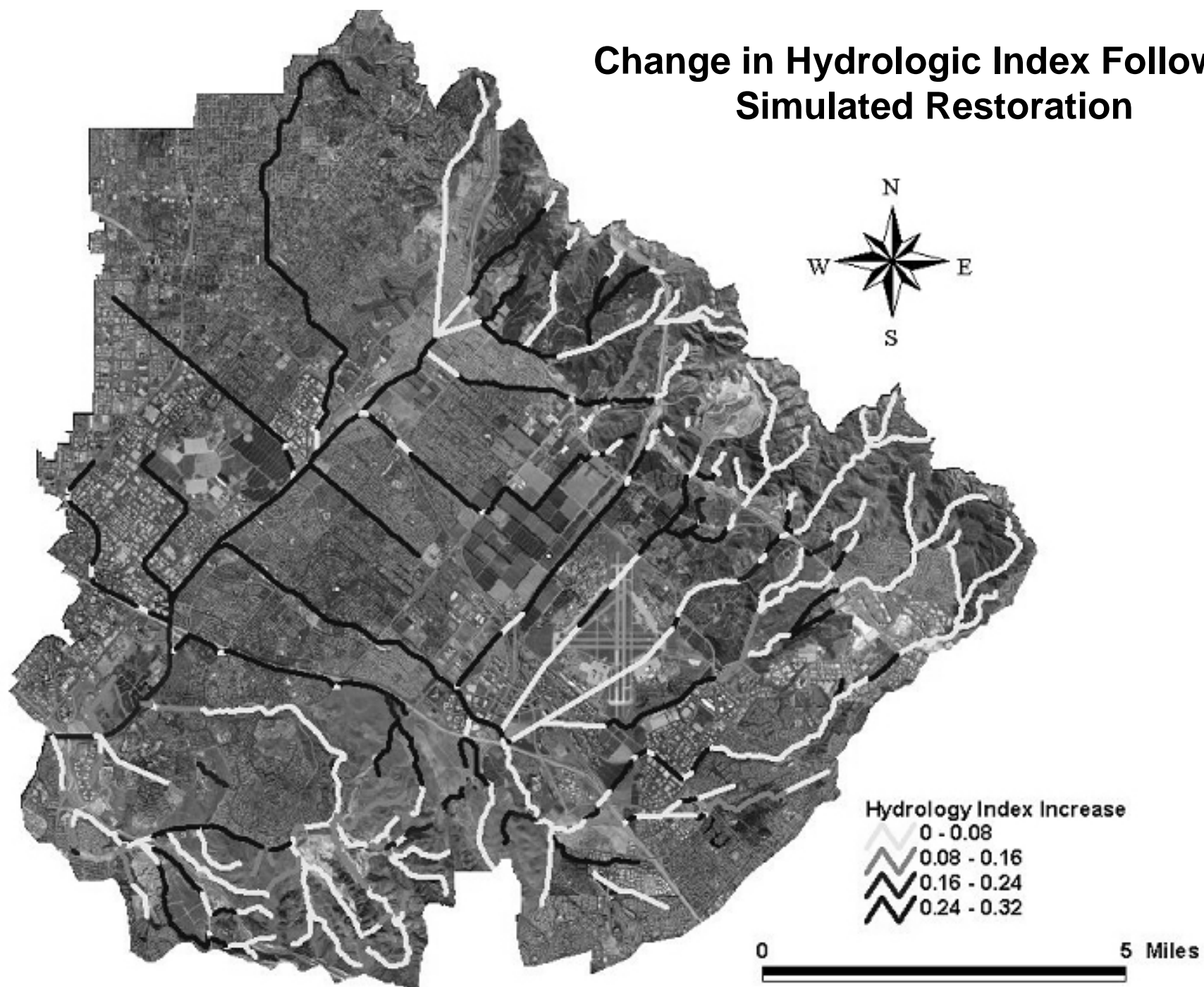
Width: NA

Height Above Bankfull: NA

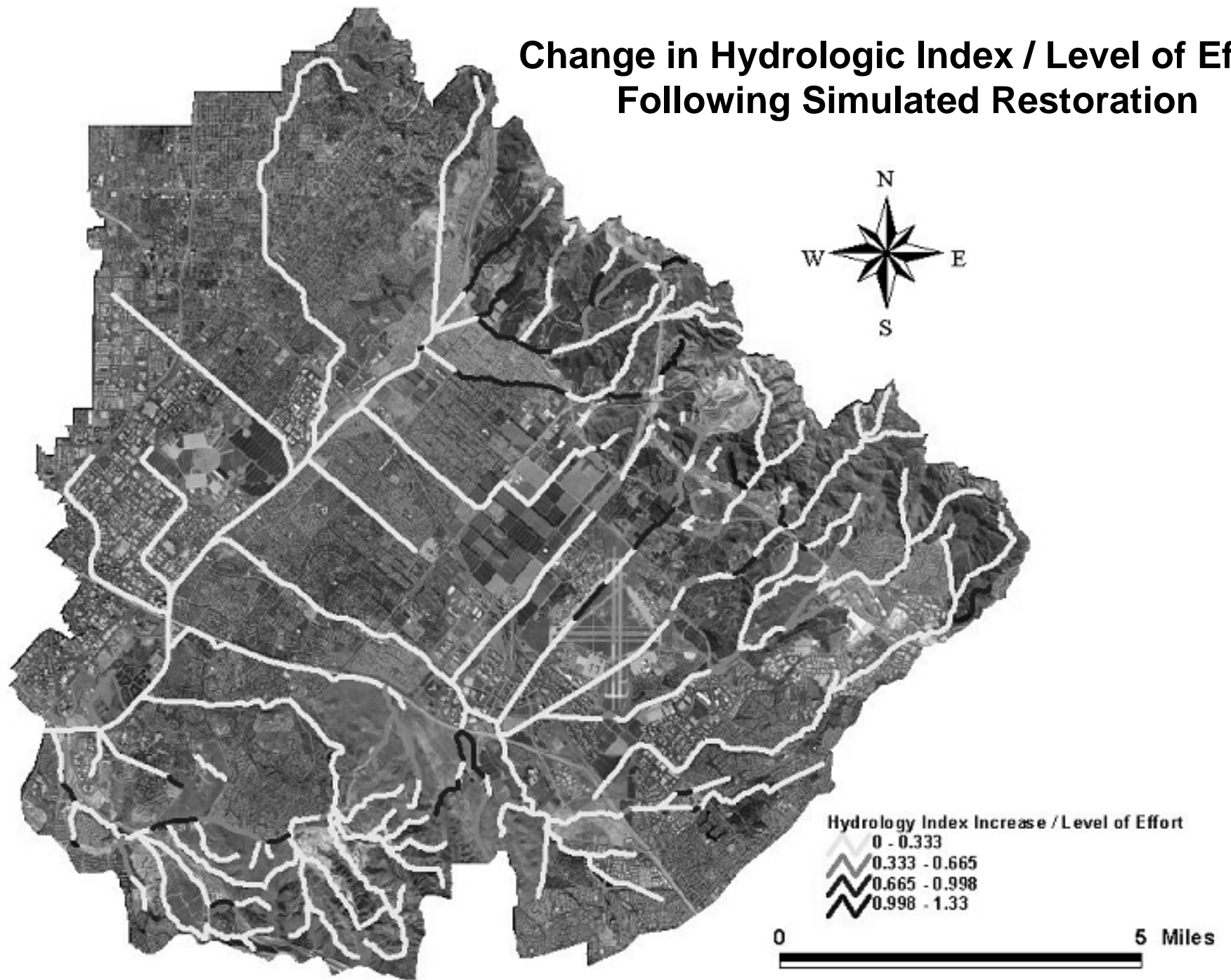
Level of Effort Assignments



Change in Hydrologic Index Following Simulated Restoration



Change in Hydrologic Index / Level of Effort Following Simulated Restoration



Phase 5: Supplementary Studies

- Test and validate hydrologic, water quality, and habitat indicators using traditional methods such as:
 - Hydrologic Simulation Program Fortran (HSPF)
 - Distributed hydrologic/water quality model (GSSHA)
 - Terrestrial Index of Biological Integrity (TIBI)

